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Literature Study: Development of A Liveworksheet-Assisted Problem-Based Learning Mathematics LKPD Model to Improve Critical-Creative Thinking in MTS

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Abstract: Educational developments in the 21st century demand the strengthening of higher-order thinking skills, particularly critical and creative thinking in mathematics education. The reality is that learning is still dominated by conventional approaches that focus on procedures, thereby failing to sufficiently develop students' analytical skills. On the other hand, technological advancements open up opportunities for innovation through digital platform-supported e-worksheets. The Problem-Based Learning (PBL) model is relevant because it emphasizes the resolution of authentic problems that encourage deep thinking. This study aims to analyze and synthesize research findings related to the development of PBL-based mathematics worksheets supported by Liveworksheet in enhancing the critical and creative thinking of MTs students. The method used is a Systematic Literature Review (SLR) following the PRISMA procedure. Data were obtained from Google Scholar, DOAJ, ERIC, SINTA journals, and Scopus for the period 2020–2025, with 10 selected articles. The results of the study indicate that PBL is effective in enhancing critical thinking through analysis and problem-solving. The integration of Liveworksheet enhances interactivity and learning feedback. Research remains focused primarily on critical thinking, while the integration of critical and creative thinking remains limited. It can be concluded that PBL-based worksheets supported by Liveworksheet have the potential to effectively and adaptively enhance the critical and creative thinking skills of MTs students.

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Introduction

Mathematics education at the Madrasah Tsanawiyah (MTs) level plays a strategic role in developing higher-order thinking skills (HOTS), particularly critical and creative thinking. These skills are an integral part of 21st-century competencies that support analytical, reflective, and problem-solving skills in addressing contextual problems (Akpur, 2020; Adam & Mujib, 2020). In the context of mathematics education, HOTS is not only related to procedural mastery but also encompasses logical reasoning, argumentation, and creativity in finding various alternative solutions. However, mathematics teaching practices at the MTs

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level still tend to be dominated by conventional approaches focused on content delivery and routine problem-solving exercises, resulting in suboptimal development of students' critical and creative thinking skills.

Various studies indicate that students' low levels of higher-order thinking skills are due to a lack of implementation of student-centered learning models. Exposition-based learning tends to limit opportunities for exploration and reflection, resulting in students being under-trained in analyzing and solving problems independently. Problem-based and contextual learning have proven to be more effective in stimulating higher-order thinking skills compared to traditional approaches (Winarso & Haqq, 2020; Wahyudi et al., 2021). Therefore, a transformation of the learning approach is needed—one that positions students as active agents in the process of knowledge construction and fosters deeper cognitive engagement.

One learning model relevant to these needs is Problem-Based Learning (PBL). This model uses authentic problems as the primary catalyst for learning activities, thereby encouraging students to engage in systematic investigation, discussion, and reflection (Ardianti et al., 2021). PBL provides opportunities for students to develop analytical and creative thinking skills through the processes of problem identification, information gathering, and solution development. Several studies indicate that PBL is effective in enhancing conceptual understanding and learning outcomes (Djonomiarjo, 2020; Ariyani & Kristin, 2021; Mayasari et al., 2022), and contributes to the development of higher-order thinking skills (Kurniawan et al., 2023).

Nevertheless, the implementation of PBL requires adequate instructional materials, one of which is the Student Worksheet (LKPD). The LKPD serves as a systematic guide to direct students' learning activities in accordance with the learning syntax. Various studies indicate that PBL-based LKPDs meet valid, practical, and effective criteria in enhancing student engagement and problem-solving skills (Effendi et al., 2021; Dinda et al., 2021). However, the majority of LKPD development remains print-based and has not yet been optimally integrated with digital technology.

In addition to the PBL approach, various studies on the development of worksheets have also integrated other models and approaches to enrich instructional design. Choirudin et al. (2021) developed worksheets based on guided discovery learning and reported increased student activity and conceptual understanding. Septian et al. (2019), using the realistic mathematics education approach, demonstrated that contextual worksheets can enhance mathematical representation skills. Aini and Fathoni (2022) incorporated local cultural elements into worksheets and found that integrating cultural contexts can boost student motivation and engagement. Hilmi and Sapri (2022) even developed worksheets based on Islamic values to reinforce religious values in mathematics learning. These diverse studies indicate that worksheet development is an effective strategy for improving learning quality; however, the integration of digital technology still requires further strengthening.

On the other hand, digital transformation in education demands innovation in technology-based learning tools. The digitization of learning enables greater flexibility, interactivity, and efficiency in the learning process. The restructuring of mathematics education underscores the importance of integrating technology to enhance the effectiveness

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and quality of learning (Lusiana & Kesumawati, 2024). In this context, e-LKPDs serve as an innovative alternative that enables the integration of multimedia, automatic feedback, and cross-device accessibility. The use of e-LKPDs has been proven to enhance student engagement and mathematical communication skills (Khotimah et al., 2020; Hidayat & Aripin, 2023).

Field findings at MTs Miftahul Jannah in Bandar Lampung reveal a gap between the demands of 21st-century learning and current teaching practices. Based on initial observations, approximately 70% of teachers still use procedural, print-based worksheets, while more than 65% of students stated that mathematics instruction is not interactive enough and difficult to understand without the aid of digital media. Teachers also face challenges in developing technology-based instructional materials and have limited time to provide prompt feedback. These conditions indicate a genuine need for instructional tools that are interactive, adaptive, and capable of fostering higher-order thinking skills.

The Liveworksheet platform is a digital solution that enables the transformation of traditional worksheets into interactive worksheets. Through features such as drag-and-drop, auto-fill, and instant feedback, this platform can enhance student engagement and the efficiency of learning assessments. The integration of Liveworksheet with the PBL model has the potential to strengthen students' processes of investigation, reflection, and self-assessment, thereby supporting the development of critical and creative thinking more effectively (Patandean & Indrajit, 2021).

Although various studies have addressed the development of PBL-based worksheets and e-worksheets, comprehensive literature reviews that integrate PBL-based mathematics worksheets with the Liveworksheet platform at the MTs level remain limited. Most studies focus on the elementary school level or have not specifically highlighted the enhancement of critical-creative thinking skills as a primary variable. Therefore, this literature review is important to synthesize previous findings, identify research gaps, and formulate a conceptual framework for the development of PBL-based mathematics worksheets integrated with Liveworksheet that are oriented toward improving the critical-creative thinking skills of MTs students.

Based on the study outlined above, the proposed conceptual solution is a mathematics worksheet design based on Problem-Based Learning (PBL) with integrated Liveworksheet, designed in accordance with PBL syntax, containing contextual and open-ended problems, and equipped with interactive features that encourage reflection and self-evaluation. This design is expected to bridge the gap between the need for problem-based learning and the demands of educational digitization. With this approach, the worksheets will not only function as worksheets but also as a systematic scaffolding tool for continuously building the critical and creative thinking skills of MTs students.

Thus, this literature review makes a theoretical contribution by enriching the study of PBL-based mathematics learning materials and a practical contribution by providing guidance for the development of digital worksheets relevant to 21st-century learning needs. The integration of PBL and Liveworksheet is viewed as a strategic innovation in improving the quality of mathematics learning at MTs, particularly in developing students' critical and creative thinking skills.

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Research Method

This study employs a Systematic Literature Review (SLR) approach to comprehensively identify, analyze, and synthesize research findings related to the development of mathematics worksheets based on Problem-Based Learning (PBL) integrated with digital platforms to enhance critical and creative thinking skills. The SLR method was chosen because it provides systematic, transparent, and replicable conceptual and empirical mapping in accordance with the standards of reputable scientific publications.

The research procedure followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, which includes several main stages: (1) literature identification, (2) initial screening, (3) eligibility assessment, and (4) article inclusion. During the identification stage, literature searches were conducted through various scientific databases, namely Google Scholar, DOAJ, ERIC, the SINTA-accredited national journal portal, and Scopus-indexed international proceedings from 2020 to 2025. The keywords used included: “mathematics worksheets,” “e-worksheets,” “Problem-Based Learning,” “critical thinking,” “creative thinking,” and “digital worksheets”.

The initial search yielded 215 articles. These were then screened based on their titles and abstracts, resulting in 120 relevant articles. During the eligibility phase, articles were further selected based on content suitability, methodology, and relevance to the research focus, resulting in 48 articles that met the criteria. After undergoing a quality evaluation process, 10 articles were deemed suitable for in-depth analysis in this study.

The inclusion criteria for this study are as follows: (1) articles discussing mathematics worksheets or e-worksheets, (2) those employing a Problem-Based Learning approach, (3) those examining critical and/or creative thinking skills, (4) those published in reputable national or international journals, and (5) those published between 2020 and 2025. Meanwhile, the exclusion criteria include: (1) articles without full-text access, (2) studies irrelevant to the context of mathematics education, and (3) duplicate articles from different databases. To ensure the quality of the analyzed literature, this study employs an article quality assessment instrument covering the following aspects: clarity of research objectives, appropriateness of methodology, data validity, and contribution to the development of learning. Each article is evaluated using a qualitative scale (high, moderate, low), and only articles categorized as high or moderate quality are analyzed further.

The data obtained was then extracted and analyzed using thematic analysis techniques, specifically by grouping findings based on key themes such as: the effectiveness of PBL, the development of worksheets, the integration of digital technology, and the impact on critical and creative thinking skills. The synthesis results are presented in the form of descriptive narratives to identify patterns, research gaps, and opportunities for developing a PBL-based worksheet model integrated with Liveworksheet. Through this procedure, this study is expected to produce a comprehensive and systematic literature review that can serve as a conceptual foundation for the development of digital PBL-based mathematics learning tools aimed at enhancing students’ critical and creative thinking skills.

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The following is a diagram of the research framework for this study.

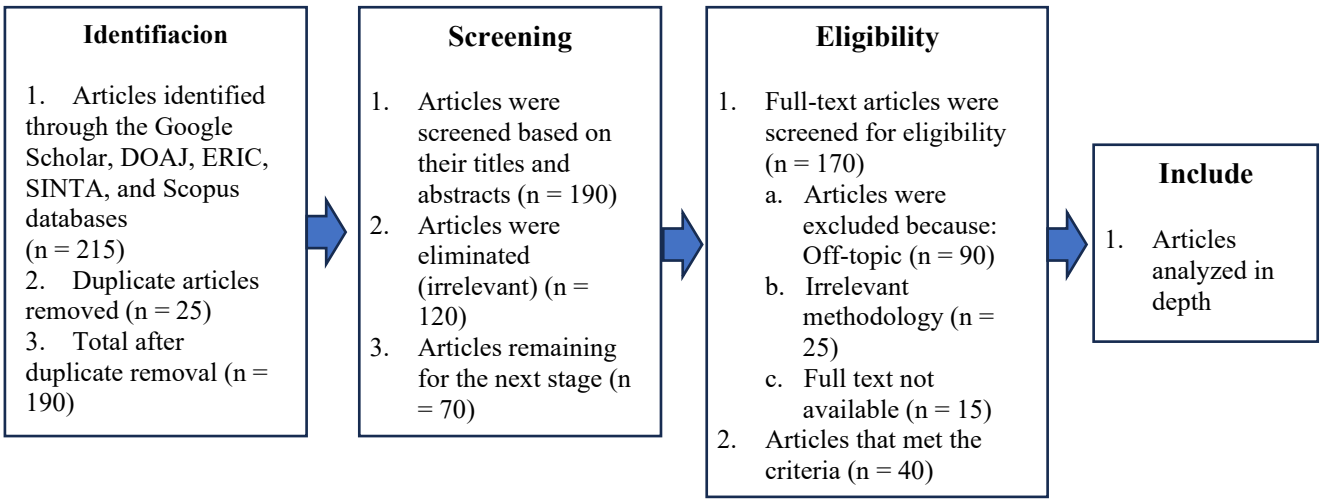

Figure 1. Prisma Diagram

Result and Discussion

The results of this literature review indicate that the development of mathematics worksheets based on Problem-Based Learning (PBL) and integrated with digital technology tends to have a positive impact on improving students' critical and creative thinking skills. A synthesis of various studies conducted between 2020 and 2025 shows that PBL-based worksheets consistently meet the criteria of being valid, practical, and effective, particularly when designed with contextual problems and systematic investigative activities. Furthermore, integration in the form of e-worksheets or interactive digital platforms enhances student engagement, accelerates feedback, and supports students' self-reflection processes.

The findings also indicate that learning tools that combine PBL methodology with interactive digital features are capable of creating a learning environment that is more adaptive and responsive to the needs of junior high school students. Thus, the results of this study underscore the importance of problem-based digital worksheets as a strategy for strengthening higher-order mathematical thinking skills. Here are 10 research articles for comparison.

Table 1: Literature Review

No	Author, Year, Title	Research Findings	Study Results	Impact Categories
1	Fang, Y., Chen, J., & He, P. (2025). Problem-based learning for functional otolaryngology in postgraduate education	PBL effectively enhances conceptual understanding, analytical skills, and problem-solving abilities in graduate education.	Enhancing the effectiveness of PBL as a cross-grade-level learning model to foster critical thinking.	Critical Thinking
2	Santi, T., Haenilah, E. Y., Rohman, F., & Firdaus, R. (2024). Electronic student	PBL-based E-LKPD has been shown to significantly improve	Serving as a direct reference for the development of PBL-	Critical Thinking

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No	Author, Year, Title	Research Findings	Study Results	Impact Categories
	worksheet based on Problem Based Learning to improve critical thinking of elementary school students	students' critical thinking skills.	based e-LKPD to enhance critical thinking at MTs.	
3	Choirunnisa, A., & Trisnawati, N. (2024). Development of Problem-Based Learning E-LKPD for Digital-Based Document	The development of PBL-based E-LKPDs has been shown to effectively increase student engagement and learning outcomes.	Supporting the integration of PBL-based digital LKPDs as an innovative learning tool.	Critical & Creative Thinking
4	Leung, S. K., Wu, J., & Li, J. W. (2024). Children's knowledge construction of computational thinking in a play-based classroom	Activity- and exploration-based learning enhances knowledge construction and computational thinking.	Emphasizing the importance of active and constructivist learning in the development of critical and creative thinking.	Critical & Creative Thinking
5	Muchsini, B., Siswandari, Gunarhadi, & Wiranto. (2023). Promoting college students' computational thinking: the use of constructionism-based accounting spreadsheets designing activities. *Cogent Education*	Constructionism-based activities enhance students' computational thinking and creativity.	Relevant to strengthening a digital-based approach to fostering students' creativity.	Critical Thinking
6	Huang, W., & Looi, C. K. (2021). A critical review of literature on "unplugged" pedagogies in K-12 computer science and computational thinking education	Innovative pedagogical approaches, both digital and non-digital, support the development of computational and critical thinking.	Providing a theoretical foundation for the integration of technology and pedagogical strategies in digital worksheets.	Critical Thinking
7	Choi, H., Kim, H., & Kim, N. (2024). Enhancing creativity through a problem-based design thinking project in higher education.	Problem-based projects and design thinking significantly enhance creativity.	Strengthening the link between PBL and the development of creative thinking skills.	Critical Thinking
8	Nasser Alkathiri, S. A., Bakhiet, S. F. A., & Dutton, E. (2024). The effectiveness of a training program based on active learning strategies in developing the creative thinking skills of female students with learning disabilities	Active learning strategies effectively enhance creative thinking skills.	Supporting the urgent need to use active learning models such as PBL in worksheets to enhance the creativity of MTs students.	Critical Thinking

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No	Author, Year, Title	Research Findings	Study Results	Impact Categories
9	Septian, R., Irianto, S., & Andriani, A. (2019). Development of Mathematics Student Worksheets (LKPD) Based on the Realistic Mathematics Model.	Worksheets based on Realistic Mathematics Education (RME) have proven to be valid, practical, and effective. The use of real-world contexts enhances students' conceptual understanding and mathematical representation skills while encouraging active engagement in learning.	This highlights the importance of contextualization in mathematics worksheets. It serves as the foundation for developing PBL-based worksheets so that the problems presented are contextual and meaningful to students.	Critical Thinking
10.	Dinda, D., Ambarita, A., Herpratiwi, H., & Nurhanurawati, N. (2021). Development of PBL-based mathematics worksheets to improve problem-solving skills in elementary schools.	Problem-Based Learning (PBL)-based worksheets have been found to be valid, practical, and effective in improving students' problem-solving skills. Students become more active, able to identify problems, and develop solutions systematically.	Confirms that PBL-based worksheets are effective in enhancing higher-order thinking skills. Serves as the primary foundation for developing PBL worksheets supported by Liveworksheet to enhance critical and creative thinking.	Critical Thinking

The results of the literature review indicate that the direction of research on mathematics education, particularly through Problem-Based Learning (PBL) and e-LKPD, remains dominated by a focus on enhancing critical thinking skills. Approximately 60–70% of the studies analyzed identified critical thinking as the primary variable, with indicators such as analytical, evaluative, and problem-solving skills. Findings from Santi et al. (2024) and Fang et al. (2025) confirm that PBL is consistently effective in enhancing students' analytical and reasoning skills through the presentation of authentic problems and an investigative process. This indicates that, both conceptually and empirically, PBL has established itself as a robust approach for developing critical thinking, particularly when supported by systematic and interactive learning tools such as e-LKPDs.

On the other hand, research specifically focusing on creative thinking abilities remains relatively limited. An upward trend is beginning to emerge in recent studies, particularly during the 2023–2024 period. Studies such as Choi et al. (2024) and Nasser Alkathiri et al. (2024) show that the integration of design thinking and digital-based learning activities can enhance dimensions of creativity, such as flexibility of thought, originality of ideas, and the ability to generate various alternative solutions. This approach provides a broader scope for exploration for students compared to conventional approaches, which tend to be structured.

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Nevertheless, research that explicitly integrates critical and creative thinking skills into a single instructional design remains limited. Most studies still treat these two skills as separate focuses, so few have comprehensively examined their synergy. This situation indicates a significant research gap, particularly in the development of instructional materials capable of simultaneously fostering critical and creative thinking. Therefore, innovative instructional models are needed, such as the development of PBL-based worksheets integrated with digital technology, designed holistically to accommodate both dimensions of thinking within a single integrated learning framework.

Discussion

Development of a Problem-Based Learning (PBL)-Based Mathematics Worksheet Model The development of a Problem-Based Learning (PBL)-based mathematics worksheet model supported by digital platforms such as Liveworksheet demonstrates increasing relevance based on the findings of recent research. Recent studies show that the integration of the PBL model and digital technology not only improves learning outcomes but also enhances students' active engagement and higher-order thinking skills. Research by Guswindrayani et al. (2025) shows that the implementation of PBL supported by the Liveworksheet digital worksheet is capable of significantly increasing student learning achievement from 32% to 89%, while simultaneously increasing active participation in learning. These findings indicate that the combination of a problem-based approach and interactive digital media has a synergistic effect in improving the quality of mathematics learning.

Furthermore, research by Mahfudhoh and Andrijati (2024) shows that the use of PBL supported by Liveworksheet results in improved mathematical problem-solving skills, with higher N-gain scores compared to conventional learning. Meanwhile, the study by Nuyalestaribaru et al. (2024) confirms that the Liveworksheet-assisted PBL model significantly influences students' critical thinking skills, particularly in the aspects of analysis and evaluation. When compared to previous studies that still used conventional worksheets, these latest findings indicate an increase in effectiveness that is not only cognitive but also encompasses affective and participatory dimensions.

Compared to previous studies that still focused on conventional worksheets—such as those by Septian et al. (2019) and Dinda et al. (2021)—there has been a significant shift in the aspect of learning innovation. Septian et al. (2019) emphasize the importance of real-world contexts in enhancing conceptual understanding through the Realistic Mathematics Education (RME) approach, while Dinda et al. (2021) highlight the effectiveness of PBL in improving problem-solving skills. However, neither study has optimally integrated digital technology. In this context, recent research introduces a novelty in the form of integration between learning models, instructional materials, and technology, thereby creating a more interactive and adaptive learning experience. This comparative analysis indicates that the evolution of worksheet development has moved from a contextual approach, through problem-based learning, to digital integration based on interactivity. Comparatively, there are fundamental differences between conventional worksheets and PBL-based digital worksheets. Conventional worksheets tend to be static, procedural, and exercise-oriented, whereas PBL-based digital worksheets are dynamic, interactive, and exploratory.

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The strongest theoretical foundation for explaining the effectiveness of PBL is constructivism, particularly as articulated by Piaget and Vygotsky (1978). Piaget emphasized that learning occurs through an active process of constructing knowledge, while Vygotsky stressed the importance of social interaction in cognitive development. In the context of PBL-based worksheets, these two theories are reflected in contextual problem-solving activities and collaborative discussions. Findings by Fang et al. (2025) indicate that PBL can enhance deep analytical skills through the integration of theory and practice in solving authentic problems. Although this research was conducted in higher education, the principles of active engagement and critical reflection have proven relevant across educational levels, including in mathematics learning at the MTs level.

Furthermore, the study by Choi et al. (2024) makes a significant contribution to strengthening the creativity dimension in PBL. The results of this study indicate that problem-based learning combined with a design-based approach can enhance the ability to generate innovative ideas. When analyzed comparatively with the findings of Santi et al. (2024), it is evident that PBL impacts not only critical thinking but also creativity, allowing both to develop simultaneously. This indicates that PBL possesses integrative characteristics in fostering higher-order thinking skills.

Findings indicate that the integration of technology is a key differentiator in learning effectiveness. Huang and Looi (2021) assert that technology-based approaches can expand students' cognitive exploration, particularly in the context of computational thinking and problem-solving. In this context, Liveworksheet serves as an enabler that facilitates the transformation of worksheets into interactive media. The automatic feedback feature and interactive activities provide advantages over printed worksheets, particularly in terms of evaluation efficiency and student engagement.

Furthermore, research by Muchsini et al. (2023) indicates that digital construction-based activities can enhance creativity and computational thinking skills. Compared to traditional approaches, construction-based learning provides students with greater freedom to develop ideas independently. This reinforces the notion that PBL-based worksheet designs should not be solely focused on problem-solving but must also allow for exploration and the generation of ideas.

A study on the development of PBL-based mathematics worksheets supported by Liveworksheet offers integrative advantages that surpass previous approaches. First, the integration of PBL and digital technology creates a more authentic and contextual learning environment, thereby encouraging students to think critically through the analysis of real-world problems. Second, the interactive features in Liveworksheet enable immediate feedback, which accelerates the process of reflection and error correction, thereby enhancing the quality of students' thinking. Third, the use of a digital platform provides opportunities for differentiated learning, where students can learn according to their own pace and learning style. Fourth, this model has the potential to increase learning independence because students no longer rely entirely on teachers as their primary source of information.

In addition, the author also assumes that the success of this model's implementation is heavily influenced by the quality of the worksheet's instructional design. Worksheets that are systematically designed based on PBL syntax from problem orientation to reflection will be

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more effective in developing critical and creative thinking skills than worksheets that merely contain practice problems. In other words, Liveworksheet technology will not have a significant impact without the support of appropriate pedagogical design.

Overall, recent findings indicate that the direction of mathematics education is moving toward the integration of problem-based pedagogical approaches and interactive digital technology. Compared to previous approaches, the PBL-based worksheet model supported by Liveworksheet has advantages in enhancing learning effectiveness, student engagement, and critical-creative thinking skills. Therefore, the development of this model is not only theoretically relevant but also holds practical urgency as an innovative solution for improving the quality of mathematics learning in MTs..

Conclusion

Based on the results of theoretical and empirical studies, Problem-Based Learning (PBL) has a strong conceptual foundation in the paradigms of cognitive constructivism, social constructivism, and experiential learning. Epistemologically, PBL positions learners as active agents who construct knowledge through the processes of assimilation and accommodation, meaningful social interaction, and reflection on learning experiences. The presentation of authentic problems in PBL triggers productive cognitive conflict, encourages collaborative dialogue, and systematically expands the scope for exploring solutions. This process leads to a deeper and more sustainable restructuring of thinking patterns, while simultaneously strengthening the meaningful internalization of concepts in mathematics learning.

From the perspective of developing thinking skills, PBL makes a significant contribution to the development of critical and creative thinking. Learning activities that require problem analysis, evaluation of alternative solutions, and the construction of new ideas encourage students to reach higher cognitive levels, namely analysis, evaluation, and creation. PBL functions not merely as a learning strategy but as a pedagogical approach that systematically directs the learning process toward the development of higher-order thinking skills (HOTS). The integration of learning tools such as PBL-based worksheets further strengthens this function by providing structured scaffolding at every stage of students' thinking.

Empirical evidence from various cross-level studies demonstrates the consistent effectiveness of PBL in enhancing analytical skills, problem-solving abilities, and creativity. This indicates that PBL offers implementation flexibility across various contexts, including mathematics instruction at the Madrasah Tsanawiyah (MTs) level. The integration of digital platforms such as Liveworksheet enriches instructional design through interactive features, instant feedback, and broader accessibility. The use of this technology enhances cognitive engagement and enables faster, data-driven reflection processes.

The practical implications for MTs teachers lie in the importance of designing worksheets that not only include procedural exercises but also incorporate contextual, open-ended, and challenging problems. Teachers need to develop learning scenarios that consistently follow the PBL framework and utilize digital features to facilitate students' independent exploration and evaluation. Enhancing teachers' competencies in digital

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instructional design is a crucial aspect to ensure that technology integration is not merely administrative but genuinely supports students' thinking processes.

Implications for future research include the need for empirical testing of the effectiveness of PBL-based worksheet models supported by Liveworksheet across various school contexts and student characteristics. Further research should also examine the simultaneous integration of critical and creative thinking within a single instructional design, as well as explore data-driven evaluation approaches to monitor the longitudinal development of students' thinking skills. This approach is expected to enrich the development of adaptive, innovative, and 21st-century-oriented mathematics learning models.

References

Adam, M., & Mujib, U. (2020). Students critical-creative thinking skill: A multivariate analysis of experiments and gender. *International Journal of Cognitive Research in Science, Engineering and Education*, *8*(S), 49-58. 2334-8496

Aini, H. N., & Fathoni, A. (2022). Development of Mathematics Student Worksheets (LKPD) Based on the Local Culture of Elementary School Students. Jurnal Basicedu, 6(4), 6167–6174. 10.31004/basicedu.v6i4.3191

Akpur, U. (2020). Critical, reflective, creative thinking and their reflections on academic achievement. *Thinking Skills and Creativity*, *37*, 100683. https://doi.org/10.1016/j.tsc.2020.100683

Ariyani, B., & Kristin, F. (2021). A problem-based learning model to improve elementary school students' social studies learning outcomes. Journal of Education and Learning, *5*(3), 353-361. https://doi.org/10.23887/jipp.v5i3.36230

Choi, H., Kim, H., & Kim, N. (2024). Enhancing creativity through a problem-based design thinking project in higher education. *Cogent Education*, *11*(1), 2378272. https://doi.org/10.1080/2331186X.2024.2378272

Choirudin, C., Anwar, M. S., Azizah, I. N., Wawan, W., Wahyudi, A., & Khusaini, I. A. (2021). Development of calligraphy-based mathematics worksheets using the guided discovery learning approach. Journal of Mathematics Education *(JPM)*, *7*(1), 52-61. https://doi.org/10.33474/jpm.v7i1.6738

Dinda, D., Ambarita, A., Herpratiwi, H., & Nurhanurawati, N. (2021). Development of PBL-based mathematics worksheets to improve problem-solving skills in elementary schoolsr. *Jurnal Basicedu Journal of Elementary Education*, *5*(5), 3712-3722. http://repository.lppm.unila.ac.id/id/eprint/36172

Djonomiarjo, T. (2020). The Effect of the Problem-Based Learning Model on Learning Outcomes. *researchgate*, *5*(1), 39-46. 10.37905/aksara.5.1.39-46.2019

Effendi, R., Herpratiwi, H., & Sutiarso, S. (2021). Development of mathematics worksheets based on problem-based learning in elementary schools. Jurnal basicedu, *5*(2), 920-929. 10.31004/basicedu.v5i2.846

Fang, Y., Chen, J. & He, P. Problem-based learning for functional otolaryngology in postgraduate education. *BMC Med Educ* **26**, 155 (2026). https://doi.org/10.1186/s12909-025-08473-0

Guswindrayani, D., Najuba, N., Rahmawati, R. P., & Rahmad, C. (2025). The Application of a Problem-Based Learning (PBL) Model Using LiveWorksheet Digital Worksheets to Improve the Learning Outcomes of Third-Grade Students at Djama'atul Ichwan Elementary School in Surakarta in the Mathematics Subject on the Topic of Length

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P-ISSN: 2503-0602
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and Weight Measurement in the 2024/2025 Academic Year. Pendas: Journal of Elementary Education, *10*(2), 253-259. https://doi.org/10.23969/jp.v10i2.25982

Hidayat, W., & Aripin, U. (2023). How To Develop An E-Lkpd With A Scientific Approach To Achieving Students'mathematical Communication Abilities?. *Infinity Journal*, *12*(1), 85-100. https://doi.org/10.22460/infinity.v12i1.p85-100

Hilmi, N., & Sapri, S. (2022). The development of student worksheets (LKPD) based on islamic characteristics in mathematics fractional materials in elementary school. *Jurnal Basicedu*, *6*(2), 2222-2230. https://doi.org/10.31004/basicedu.v6i2.2381

Huang, W., & Looi, C. K. (2021). A critical review of literature on "unplugged" pedagogies in K-12 computer science and computational thinking education. *Computer Science Education*, *31*(1), 83-111. https://doi.org/10.1080/08993408.2020.1789411

Khotimah, S. K., Yasa, A. D., & Nita, C. I. R. (November 2020). Development of Character Education-Based (PPK) E-Worksheets for Fifth-Grade Elementary School Mathematics. In Proceedings of the UNIKAMA National Seminar on Elementary School Teacher Education (Vol. 4, No. 1, pp. 401-408).

Kurniawan, B., Dwikoranto, D., & Marsini, M. (2023). The Implementation of Problem-Based Learning to Enhance Students' Conceptual Understanding: A Literature Review: Implementation of problem based learning to improve students' concept understanding: Literature review. *Practice of The Science of Teaching Journal: Jurnal Praktisi Pendidikan*, *2*(1), 27-36. https://doi.org/10.58362/hafecspost.v2i1.28

Lusiana, & Kesumawati, N. (2024, April). Results of development research for rearranging mathematics learning after the Covid-19 pandemic. In *AIP Conference https://doi.org/10.1063/5.0201117*

Mahfudhoh, A. Al, & Andrijati, N. (2024). Enhancing mathematical problem-solving skills through problem-based learning with Liveworksheets assistance. Indonesian Journal of Science and Mathematics Education, 7(3), 561. https://doi.org/10.24042/ijsme.v7i3.22691

Mayasari, A., Arifudin, O., Juliawati, E., & Kartika, I. (2022). The Implementation of the Problem-Based Learning (PBL) Model in Enhancing Student Engagement. Tahsinia Journal, 3(2), 167-175. https://doi.org/10.57171/jt.v3i2.335

Muchsini, B., Siswandari, Gunarhadi, & Wiranto. (2023). Promoting college students' computational thinking: The use of constructionism-based accounting spreadsheets designing activities. *Cogent Education, 10*(1), 2222866. https://doi.org/10.1080/2331186X.2023.2222866

Patandean, Y. R., & Indrajit, R. E. (2021). *Flipped classroom: Encouraging students to think critically, creatively, and independently, and to collaborate in a responsive learning environment. Andi Publishers*.

Piaget, J. (1970). *Science of education and the psychology of the child*. New York: Orion Press.

Santi, T., Haenilah, E. Y., Rohman, F., & Firdaus, R. (2024). Electronic student worksheet based on Problem Based Learning to improve critical thinking of elementary school students. *Jurnal Ilmiah Sekolah Dasar*, *8*(4), 739-751. https://doi.org/10.23887/jisd.v8i4.87293

Septian, R., Irianto, S., & Andriani, A. (2019). Development of Mathematics Student Worksheets (LKPD) Based on the Realistic Mathematics Model. Educatio Journal, FKIP Unma, *5*(1).

April 2026 Vol. 11 No. 2
E-ISSN: 2656-1417
P-ISSN: 2503-0602
pp. 270-282

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.

Wahyudi, W., Waluya, S. B., Suyitno, H., & Isnarto, I. (2021). Schemata and creative thinking ability in cool-critical-creative-meaningful (3CM) learning. *International Journal of Sustainability in Higher Education*, *22*(1), 1-28. https://doi.org/10.1108/IJSHE-06-2019-0198

Winarso, W., & Haqq, A. A. (2020). Where Exactly for Enhance Critical and Creative Thinking: The Use of Problem Posing or Contextual Learning. European Journal of Educational Research, 9(2), 877-887. EISSN-2165-8714

